

**RISK ASSESSMENT REPORT  
DIXON WEAREVER CO.,  
DEER LAKE, PENNSYLVANIA**

**Prepared for:**

**Dixon Wearever Company**



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## TABLE OF CONTENTS

### PAGENO.

1.0	INTRODUCTION . . . . .	1
2.0	SOURCES OF INFORMATION . . . . .	2
3.0	SITE SPECIFIC COMPOUNDS AND ELEMENTS FOR RISK ASSESSMENT. . . . .	3
4.0	CHEMICAL TOXICITY. . . . .	4
5.0	EXPOSURE PATHWAYS. . . . .	6
6.0	RISK ASSESSMENT: VOC'S	
6.1	VOC CONCENTRATIONS USED IN RISK ASSESSMENT	
6.1.1	ON-SITE	
6.1.1.1	GROUNDWATER . . . . .	8
6.1.1.2	SOILS . . . . .	10
6.1.2	OFF-SITE GROUNDWATER . . . . .	10
6.2	CHEMICAL INTAKE CALCULATIONS: VOC'S IN GROUNDWATER. . . . .	13
6.3	CALCULATION OF CARCINOGENIC RISK: VOC'S IN GROUNDWATER. . . . .	14
6.4	CALCULATION OF NON-CARCINOGENIC RISKS: VOC'S IN GROUNDWATER. . . . .	16
6.5	CALCULATION OF RISK: VOC'S IN SOIL. . . . .	17
7.0	RISK ASSESSMENT: METALS	
7.1	FATE AND TRANSPORT ASSESSMENT	
7.1.1	GENERAL. . . . .	18
7.1.2	MODELLING CALCULATIONS . . . . .	18
7.2	CALCULATION OF METALS INTAKE	
7.2.1	INGESTION OF GROUNDWATER . . . . .	26
7.2.2	INGESTION OF SOIL. . . . .	27
7.3	CALCULATION OF NON-CARCINOGENIC RISK: PRESENT GROUNDWATER USE . . . . .	29
7.4	FUTURE GROUNDWATER USE. . . . .	30
7.5	CALCULATION OF NON-CARCINOGENIC RISK: INGESTION OF SOIL . . . . .	32
7.6	CARCINOGENIC EFFECTS OF METALS. . . . .	33
7.7	RISKS ASSOCIATED WITH DERMAL CONTACT WITH METALS IN SOIL	
7.7.1	CALCULATION OF ABSORBED DOSE . . . . .	34
7.7.2	CALCULATION OF NON-CARCINOGENIC RISK . . . . .	36
8.0	ECOLOGICAL RISK ASSESSMENT . . . . .	37
9.0	CONCLUSIONS. . . . .	39

### APPENDIX

EXHIBIT I: PROJECTED METALS PLUME IN GROUNDWATER AT DIXON WEAREVER. . . . .	Back Pocket
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## LIST OF TABLES

### PAGENO.

TABLE 1A:	TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC EFFECTS . . . . .	4
TABLE 1B:	TOXICITY VALUES POTENTIAL CARCINOGENIC EFFECTS. .	5
TABLE 2A:	POTENTIAL EXPOSURE PATHWAYS: PRESENT LAND USE . .	6
TABLE 2B:	POTENTIAL EXPOSURE PATHWAYS: POSSIBLE FUTURE RESIDENTIAL LAND USE . . . . .	7
TABLE 3A:	VOC CONCENTRATIONS USED IN RISK ASSESSMENT. . . .	8
TABLE 3B:	VOC CONCENTRATIONS USED IN RISK ASSESSMENT: OFF-SITE GROUNDWATER. . . . .	13
TABLE 4A:	CALCULATED VOC INTAKE VOLUMES: ON-SITE GROUNDWATER . . . . .	14
TABLE 4B:	LINEAR LOW DOSE CARCINOGENIC RISK FOR VOC'S: OFF-SITE GROUNDWATER. . . . .	14
TABLE 5A:	LINEAR LOW DOSE CARCINOGENIC RISK FOR VOC'S: ON-SITE GROUNDWATER . . . . .	15
TABLE 5B:	LINEAR LOW DOSE CARCINOGENIC RISK FOR VOC'S: OFF-SITE GROUNDWATER. . . . .	15
TABLE 6A:	NON-CANCER HAZARD QUOTIENTS FOR VOC'S IN DRINKING WATER: ON-SITE . . . . .	16
TABLE 6B:	NON-CANCER HAZARD QUOTIENTS FOR VOC'S IN DRINKING WATER OFF-SITE . . . . .	16
TABLE 7:	METALS CONCENTRATIONS IN AREAS #1, #4 AND #7. . .	20
TABLE 8:	CONCENTRATIONS OF METALS IN INFILTRATE REACHING GROUNDWATER. . . . .	21
TABLE 9:	VOLUMES OF INFILTRATION REACHING GROUNDWATER FOR AREAS #1, #4 AND #7 . . . . .	22
TABLE 10:	AVERAGE CONCENTRATIONS OF METALS IN INFILTRATE FROM AREAS #1, #4 AND #7 . . . . .	23
TABLE 11:	CALCULATIONS OF METALS CONCENTRATIONS IN GROUNDWATER AT POINTS DOWNGRADIENT. . . . .	25

LIST OF TABLES CONT'D

PAGE NO.

TABLE 12:	INTAKE EQUATION PARAMETERS. . . . .	27
TABLE 13:	INTAKE OF METALS THROUGH INGESTION OF GROUNDWATER . . . . .	27
TABLE 14:	INTAKE EQUATION PARAMETERS. . . . .	28
TABLE 15:	CALCULATED CHEMICAL INTAKES . . . . .	29
TABLE 16:	RISK CALCULATIONS FOR INGESTION OF GROUNDWATER: METALS . . . . .	29
TABLE 17:	NON-CARCINOGENIC RISK CALCULATIONS, INGESTION OF GROUNDWATER UNDER POSSIBLE FUTURE RESIDENTIAL LAND USE. . . . .	32
TABLE 18:	NON-CARCINOGENIC RISK: INGESTION OF SOIL. . . . .	32
TABLE 19:	ABSORBED DOSE EQUATION PARAMETERS FOR DERMAL CONTACT WITH SOIL. . . . .	35
TABLE 20:	CALCULATED ABSORBED DOSES, DERMAL CONTACT WITH METALS IN SOIL . . . . .	35
TABLE 21:	NON-CARCINOGENIC RISK: DERMAL CONTACT WITH SOIL. . . . .	36

## 1.0 INTRODUCTION

In September of 1990, the Dixon Wearever Corporation (Dixon) submitted a RCRA Facility Investigation (RFI) Report for its Deer Lake, Pennsylvania facility to the U.S. Environmental Protection Agency (EPA). In response to technical comments from EPA on the first draft of the RFI report, a revised report was submitted in July of 1991. The revised RFI report stated that a baseline risk assessment would be conducted for the site using data collected during the RFI and also during previous investigations.

This report contains the baseline risk assessment for the Dixon site as well as the fate and transport modelling that was necessary to support the risk assessment. This risk assessment report is a supplement to the RFI report. It will draw heavily on data contained in the RFI report and other reports, such as the Existing Conditions Report. These reports will be referenced, but the information contained in them will not be reproduced in this report.

This risk assessment will focus on the health risks, if any, posed by the chlorinated volatile organic chemicals that have been detected in the groundwater at the Dixon site, and by the heavy metals that have been detected in areas #1, #4 and #7 during the RFI.

This risk assessment report was first submitted to EPA in September

of 1991. It was subsequently revised and resubmitted in January of 1992, based upon an EPA comments letter of December 2, 1991 (Appendix I).

## 2.0 SOURCES OF INFORMATION

The following documents were used as references to obtain site specific and general information for this risk assessment.

Hoover, et al, 1971, Properties and Uses of Pennsylvania Shales and Clays; PaDER Mineral Resources Report M 63, 329 p.

INTEX, December, 1988, Existing Conditions and the State of Contamination at Dixon Wearever, Deer Lake, PA.

INTEX, July 1991, RCRA Facility Investigation Report, Dixon Wearever, Deer Lake, Pa.

US EPA, March 1989, Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual; EPA 540 1-89 001.

US EPA, October 1989, Determining Soil Response Action Levels Based on Potential Contaminant Migration to Ground Water: A Compendium of Examples; EPA 540 2-89 057.

US EPA, December 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A); EPA 540 1-89 002.

US EPA, September 1990, Health Effects Assessment Summary Tables, Fourth Quarter FY-1990; NTIS No. PB90-921104.

Wright Associates, 1983, Special Groundwater Study of the Middle Delaware River Basin Study Area II.

### 3.0 SITE SPECIFIC COMPOUNDS AND ELEMENTS FOR RISK ASSESSMENT

There are two general categories of potential contaminants of concern at the site on which the risk assessment focused. They are chlorinated volatile organic chemicals (VOC's) and heavy metals. The organics on which the risk assessment focused were trichloroethylene, 1,1,1-trichloroethane, 1,1-dichloroethylene, 1,1-dichloroethane and 1,2-dichloroethylene. These are the only VOC's which have been consistently detected on the site since investigations began in 1984. The metals on which the risk assessment focused were lead, arsenic, cadmium and chromium. Heavy metals (and other metals) occur naturally in the soils on the site. However, these four metals were found to present in ash and debris in concentrations above background levels. As discussed in the RFI report, soil, ash and debris was removed from areas #4 and #7 in an effort to reduce concentrations of these metals.

The sources of the VOC's and metals are unrelated. The VOC's originated from the overflow or leakage of two evaporation lagoons (now closed) and the metals are found in 3 areas of soil, ash and debris on the Dixon property west of the facility (areas #1, #4 and #7 in RFI report).

#### 4.0 CHEMICAL TOXICITY

Based on the US EPA Health Effects Summary Tables, the VOC's and metals were evaluated for chronic and sub-chronic toxicity and carcinogenicity. Tables 1A and 1B list toxicity and carcinogenicity data for the site specific VOC's and metals.

TABLE 1A  
TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC EFFECTS

CHEMICAL =====	CHRONIC RfD (mg/kg-day) =====	SUB-CHRONIC RfD (mg/kg-day) =====	CRITICAL EFFECT =====	UNCERTAINTY FACTOR =====
lead, inhalation <sup>1</sup>	4.3 x 10 <sup>-4</sup>	ND	ND	ND
lead, oral <sup>1</sup>	1.4 x 10 <sup>-4</sup>	ND	ND	ND
arsenic, inhalation	1 x 10 <sup>-3</sup>	1 x 10 <sup>-3</sup>	keratosis & hyperpigmentation	1
arsenic, oral	1 x 10 <sup>-3</sup>	1 x 10 <sup>-3</sup>	keratosis & hyperpigmentation	1
cadmium, inhalation	1 x 10 <sup>-3</sup> (food) 5 x 10 <sup>-4</sup> (water)	ND	cancer	10
cadmium, oral	1 x 10 <sup>-3</sup> (food) 5 x 10 <sup>-4</sup> (water)	ND	cancer, renal damage	10
chromium (VI), in- halation	2 x 10 <sup>-6</sup>	2 x 10 <sup>-5</sup>	nasal mucosa atrophy	30 (sub) 300 (chronic)
chromium, (VI) oral	5 x 10 <sup>-3</sup>	2 x 10 <sup>-2</sup>	ND	100 (sub) 300 (chronic)
chromium (III), in- halation	2 x 10 <sup>-6</sup>	2 x 10 <sup>-5</sup>	nasal mucosa atrophy	30 (sub) 300 (chronic)
chromium (III), oral	1	1 x 10 <sup>-1</sup>	nasal mucosa atrophy	100 (sub) 1000 (chronic)
1,1-dichloroethane inhalation	1 x 10 <sup>-1</sup>	5	hepatotoxicity kidney damage	100 (sub) 1000 (chronic)
1,1-dichloroethane oral	1 x 10 <sup>-1</sup>	1	none	100 (sub) 1000 (chronic)
1,1-dichloroethylene inhalation	9 x 10 <sup>-3</sup>	9 x 10 <sup>-3</sup>	liver lesions	1000
1,1-dichloroethylene oral	9 x 10 <sup>-3</sup>	9 x 10 <sup>-3</sup>	liver lesions	1000
1,1,1-trichloroethane inhalation	1	1 x 10 <sup>-1</sup>	hepatotoxicity	100 (sub) 1000 (chronic)
1,1,1-trichloroethane oral	9 x 10 <sup>-2</sup>	9 x 10 <sup>-1</sup>	hepatotoxicity	100 (sub)



TABLE 1A (CONT'D)

CHEMICAL =====	CHRONIC RfD (mg/kg-day) =====	SUB-CHRONIC RfD (mg/kg-day) =====	CRITICAL EFFECT =====	UNCERTAINTY FACTOR =====
1,2-c-dichloroe- thylene, inhalation	1 x 10 <sup>-2</sup>	1	decreased hemato- crit & hemoglobin	300 (sub) 3000 (chronic)
1,2-c-dichloroe- thylene, inhalation	1 x 10 <sup>-2</sup>	1	decreased hemato- crit & hemoglobin	300 (sub) 3000 (chronic)
tetrachloroethylene, inhalation	1 x 10 <sup>-2</sup>	1 x 10 <sup>-1</sup>	hepatotoxicity	100 (sub) 1000 (chronic)
tetrachloroethylene, oral	1 x 10 <sup>-2</sup>	1 x 10 <sup>-1</sup>	hepatotoxicity	100 (sub) 1000 (chronic)

<sup>1</sup> No data in Health Effects Summary Tables, data provided  
by EPA Region III.

ND - No data in Health Effects Summary Tables.

TABLE 1B

## TOXICITY VALUES POTENTIAL CARCINOGENIC EFFECTS

CHEMICAL =====	SLOPE FACTOR (mg/kg-day) =====	WEIGHT-OF-EVIDENCE CLASSIFICATION <sup>1</sup> =====	TYPE OF CANCER <sup>2</sup> =====
lead, inhalation	ND	B2	-
lead, oral	ND	B2	-
arsenic, inhalation	5 x 10 <sup>1</sup>	A	respiratory tract
arsenic, oral	ND	A	skin
cadmium, inhalation	6.1 x 10 <sup>0</sup>	B2	-
cadmium, oral	ND	ND	-
chromium (VI), inhal.	4.1 x 10 <sup>1</sup>	A	lung
1,1-dichloroethane, inhal.	ND	C	-
1,1-dichloroethane, oral	ND	C	-
1,1-dichloroethylene, inhalation	1.2 x 10 <sup>0</sup>	C	-
1,1-dichloroethylene, oral	6 x 10 <sup>-1</sup>	C	-
trichloroethylene, inhalation	1.7 x 10 <sup>-2</sup>	B2	-
trichloroethylene, oral	1.1 x 10 <sup>-2</sup>	B2	-
1,2-c-dichloroethylene	ND	ND	ND
tetrachloroethylene, inhalation	5.1 x 10 <sup>-2</sup>	B2	-
tetrachloroethylene, oral	5.1 x 10 <sup>-2</sup>	B2	-

TABLE 1B (CONT'D)

- <sup>1</sup> A - Human Carcinogen (sufficient evidence of carcinogenicity in humans)
- B - Probable Human Carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans)
- C - Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)
- D - Not Classifiable as to Human Carcinogenicity (inadequate or no evidence)
- E - Evidence of Noncarcinogenicity for Humans (no evidence of carcinogenicity in adequate studies).

<sup>2</sup> Types of cancer listed for type A carcinogens only.

ND No Data in Health Effects Summary Tables

## 5.0 EXPOSURE PATHWAYS

Because of the different sources and distribution of the VOC's and the metals, they would not share all the same exposure pathways. Furthermore, if land use were to change from its present use, exposure pathways would also change. Exposure pathways for VOC's and metals were evaluated considering the present land use and also assuming that the Dixon property were someday used for residential housing.

TABLE 2A  
POTENTIAL EXPOSURE PATHWAYS:  
PRESENT LAND USE

PATHWAY	POTENTIAL RECEPTORS	COMMENTS/REASONING
Direct contact with contaminated soil/waste		
Metals, VOC's	Dixon workers,	No reason for workers to go to these areas, areas of concern are limited in areal extent. Dixon will restrict access to these areas to all persons without authorization.

TABLE 2A (CONT'D)

PATHWAY	POTENTIAL RECEPTORS	COMMENTS/REASONING
===== Contact with or consumption of windborne particles		
Metals, VOC's	Dixon workers, downwind population	Areas are of limited areal extent, are vegetated and are surrounded by trees and shrubs, which would inhibit entrainment by wind. Downwind populations are distant and significant dispersal and dilution would probably take place.
Consumption of Groundwater		
Metals	Dixon workers, downgradient populations	Metals in question have not been detected in production well or monitoring wells above MCL's.
VOC's	Dixon workers, downgradient populations	Dixon well water treated to remove VOC's, no VOC's attributable to Dixon detected off property boundary above MCL's.

TABLE 2B

POTENTIAL EXPOSURE PATHWAYS,  
POSSIBLE FUTURE RESIDENTIAL LAND USE

EXPOSURE PATHWAY	POTENTIAL RECEPTOR	COMMENTS/REASONING
===== Direct contact with contaminated soil/waste		
Metals, VOC's	Construction workers, residents	Worker's exposure would be short-term.
Inhalation or ingestion of windborne particles		
Metals, VOC's	Construction workers, residents	Actual exposure would depend on type of ground cover at specific contaminated area.
Consumption of contaminated groundwater	Residents	

## 6.0 RISK ASSESSMENT: VOC'S

### 6.1 VOC CONCENTRATIONS USED IN RISK ASSESSMENT

#### 6.1.1 On-Site

##### 6.1.1.1 Groundwater

In order to consider worst case conditions, the four wells with the highest historical concentrations of VOC's were used in the risk assessment. It should be noted that all on-site groundwater consumption was assumed to take place without prior treatment. The wells used were #3S, #5S, #8S and the production well. Data for these wells was obtained from Table 2 of the Existing Conditions Report and Tables 13 and 14 of the RFI Report. Because some of these wells were in existence before others, the amount of data available for each well is not consistent. The actual concentrations of VOC's used in the risk assessment were obtained by calculating the upper 95% confidence interval for the mean of these values, as shown in Table 3A.

TABLE 3A

VOC CONCENTRATIONS USED IN RISK ASSESSMENT (ug/l)

WELL	TRICHLORO- ETHYLENE	1,1,1-TRICHLORO- ETHANE	1,2-DICHLORO- ETHYLENE	1,1 DICHLORO- ETHYLENE	1,1-DICHLORO- ETHANE
3S	13.00	49.00	2.50*	NA	2.50*
	15.00	89.00	1.00	NA	10.00
	25.00	90.00	11.00	NA	19.00
	18.00	74.00	0.50*	NA	12.00
	17.00	8.10	8.50	NA	8.80
	1.60	2.60	2.80	NA	2.50*
	16.50	142.00	7.00	NA	6.00
	26.00	99.00	10.00	NA	10.00
	35.00	117.00	2.50*	NA	9.40
	20.00	85.00	5.30	NA	15.40

TABLE 3A (CONT'D)

WELL	TRICHLORO- ETHYLENE	1,1,1-TRICHLORO- ETHANE	1,2-DICHLORO- ETHYLENE	1,1 DICHLORO- ETHYLENE	1,1-DICHLORO- ETHANE
3S	10.50 23.00 22.50 11.6 28.30 22.00	38.10 0.25* 62.50 54.50 79.90 52.00	2.40 15.30 0.25* 0.25* 7.63 NA	NA NA NA NA NA 3.20	2.00 0.25* 7.40* 2.91 13.80 3.20
5S	0.25* 0.25* 0.50 1.50 1.20 0.25* 3.06 1.50 1.30 2.26 2.60	1.50 16.00 8.00 21.30 24.00 0.25* 0.25* 31.00 30.30 24.90 57.00	2.70 0.45* 0.25* 0.25* 0.25* 0.25* 9.00 0.25* 0.25 0.25* NA	NA NA NA NA NA NA NA NA NA NA 0.70	0.25* 0.25* 0.70 1.26 1.40 0.25* 0.25* 0.60 0.54 1.66 0.25*
8S	30.00 24.00	80.00 57.00	NA NA	13.00 2.00	2.50* 0.25*
Production Well					
	31.40 32.00 26.00 27.00 29.80 1.80 13.00 31.00 53.00 44.30 15.20 70.00 30.40 11.60 62.30 27.00	2.50* 0.50* 15.00 0.50* 16.50 1.70 7.00 15.00 24.00 27.40 4.60 29.60 15.20 5.80 19.60 12.00	2.50* 1.00 7.00 0.50* 16.90 0.25* 2.00 7.00 0.25 6.80 3.00 0.25* 0.25* 0.25* 5.09 NA	NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA 2.50	2.50* 33.00 27.00 23.00 30.00 8.60 9.00 28.00 38.20 53.00 13.90 71.20 21.90 8.96 66.90 16.00
Mean	19.54	35.40	3.35	4.32	13.30
Upper 95% Confidence Limit					
	24.50	46.10	4.57	10.45	18.16

\* 1/2 of detection limit concentration  
all units in ug/l

NA = Compound not analyzed

The 95% confidence interval concentrations in Table 3 are considered reasonable and appropriate because they are within the same order of magnitude as historical data (Existing Conditions Report) and because wells #5s and #8s are very close to the hydraulically downgradient property boundary.

#### 6.1.1.2 Soils

Some volatile organics were detected in the soil/debris in areas #1, #4 and #7. Those compounds which were determined by the data validation process to be actually occurring were trichloroethylene and ethyl benzene (see Table 5 of RFI report). A removal action was conducted at areas #4 and #7 to remove the materials containing the volatiles and metals. However, no removal was conducted at area #1. Therefore, it is possible that trichloroethylene at a concentration of 43 ug/kg still exists in this area. This will be considered in the risk assessment.

#### **6.1.2 Off-Site Groundwater**

The off-site risk posed by volatiles is limited to consumption of groundwater. As part of the RFI, three off-site wells were sampled and analyzed for volatile organics (see Section 9.2 of RFI report). Of these three wells, 1,1,1-trichloroethane was detected in the "driving range" well at a concentration of 1.11 ug/l and xylene was detected in the "trucking company" well at a concentration of 4.86 ug/l, along with floating free product.

After volatile organics were detected at the property boundary in well #8S, Dixon had 29 downgradient wells sampled and analyzed for volatile organics. Of these wells, tetrachloroethylene was detected in one well at a concentration of 1.0 ug/l, 1,1,1-trichloroethane was detected in 2 wells at concentrations of 3.6 ug/l and 4.9 ug/l. Benzene, toluene, ethyl benzene and xylene were detected in the "trucking company" well at concentrations of 190 ug/l, 47 ug/l, 28 ug/l and 122 ug/l, respectively (see Appendix VI of RFI report).

The 1,1,1-trichloroethane has been detected in monitoring wells and the production well on the Dixon property. Tetrachloroethylene has not been detected in groundwater on Dixon property, but is a possible breakdown product or impurity of trichloroethylene, which has been detected in the groundwater at Dixon. The benzene, toluene, xylene and ethyl benzene that was detected in the trucking company well are not believed to originate on the Dixon property, as discussed below:

- The most likely source of the benzene, toluene, xylene and ethyl benzene is the free product that was present in the well. This product had the appearance and odor of diesel fuel or #2 fuel oil. Neither diesel fuel or #2 fuel oil has been stored or used at Dixon.
- Monitoring well #9S is located within 100 feet of the trucking company well and is hydraulically downgradient of the Dixon facility and the majority of the Dixon property. No benzene, xylene, toluene or ethyl benzene

has been detected in this well.

- No benzene, toluene, xylene or ethyl benzene has ever been detected in the groundwater beneath the Dixon property. If the compounds in the trucking company well had originated on the Dixon property, it is likely that they would also have been found in on-site wells.
- The benzene, toluene, xylene, ethyl benzene and free product were found in only one well. None of these constituents were detected in any of the other residential wells sampled, which are downgradient of the Dixon facility. It is extremely unlikely that a free product plume would migrate the distance from the Dixon facility to the trucking company well without being detected in any other well in either pure or dissolved phases. This is more likely a local occurrence, with the source being located relatively close to the well.

For the above reasons, the volatile aromatic hydrocarbons will not be considered in this risk assessment. Only the chlorinated volatile organics will be considered. The following assumptions will be used to obtain quantified concentrations of volatiles for off-site wells to be used in the risk assessment.

- All chlorinated volatiles that have been detected in wells on the Dixon property will be assumed to exist in all off-site wells at concentrations of one half the detection limit.
- All data from the Phase II RFI sampling and from Dixon's



sampling of residential wells will be used.

- Tetrachloroethylene will be considered in the risk assessment since it may be related to the trichloroethylene detected in the groundwater at Dixon.

Using the above assumptions, the mean and 95% upper confidence limits to used in the risk assessment for the chlorinated volatiles are shown in Table 3B.

TABLE 3B

VOC CONCENTRATIONS USED IN RISK ASSESSMENT:  
OFF-SITE GROUNDWATER

COMPOUND	MEAN (ug/l)	UPPER 95% CONFIDENCE LIMIT (ug/l)
trichloroethylene	0.25	0.25
1,1,1-trichloroethane	0.53	0.89
1,1-dichloroethylene	0.25	0.25
1,1-dichloroethane	0.25	0.25
1,2-dichloroethylene	0.25	0.25
tetrachloroethylene	0.27	0.32

## 6.2 CHEMICAL INTAKE CALCULATIONS: VOC'S IN GROUNDWATER

The following equation was used to calculate human intake of VOC's due to ingestion of groundwater (from Risk Assessment Guidance for Superfund Volume I):

$$I = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where: I = Intake (mg/kg-day)  
IR = Ingestion Rate (l/day) = 2  
EF = Exposure Frequency (days/year) = 365  
ED = Exposure Duration (years) = 70  
BW = Body Weight (kg) = 70  
AT = EF x ED  
CW = Chemical Concentration in water (mg/l)

Table 4 lists the calculated intake volumes:

TABLE 4A

CALCULATED VOC INTAKE VOLUMES: ON-SITE GROUNDWATER

COMPOUND	CW (mg/l)	I (mg/kg-day)
Trichloroethylene	0.0245	$6.86 \times 10^{-4}$
1,1,1-trichloroethane	0.0461	$1.29 \times 10^{-3}$
1,1-dichloroethylene	0.0145	$4.06 \times 10^{-4}$
1,1-dichloroethane	0.0186	$5.21 \times 10^{-4}$
1,2-dichloroethylene	0.00457	$1.27 \times 10^{-4}$

TABLE 4B

LINEAR LOW DOSE CARCINOGENIC RISK FOR VOC's:  
OFF-SITE GROUNDWATER

COMPOUND	I (mg/kg-day)	SF (mg/kg-day)	RISK
trichloroethylene	$7.12 \times 10^{-6}$	$1.1 \times 10^{-2}$	$7.84 \times 10^{-8}$
1,1,1-trichloroethane	$2.53 \times 10^{-5}$	ND	NC
1,1-dichloroethylene	$7.125 \times 10^{-6}$	$6.0 \times 10^{-1}$	$4.27 \times 10^{-6}$
1,2-dichloroethylene	$7.125 \times 10^{-6}$	ND	NC
1,1-dichloroethane	$7.125 \times 10^{-6}$	ND	NC
tetrachloroethylene	$9.12 \times 10^{-6}$	$5.1 \times 10^{-2}$	$4.65 \times 10^{-7}$
Sum of Risks			$4.81 \times 10^{-6}$

### 6.3 CALCULATION OF CARCINOGENIC RISK: VOC'S IN GROUNDWATER

The following equation was used to calculate linear low dose carcinogenic risk (from Risk Assessment Guidance for Superfund Volume I):

$$\text{Risk} = I (\text{Sf})$$

Where: I = Chronic daily intake averaged over 70 years (mg/kg-day)  
Sf = Slope factor (mg/kg-day) (from Health Effects Assessment Summary Tables).

Risk calculation results are presented in Table 5.

TABLE 5A

LINEAR LOW DOSE CARCINOGENIC RISK FOR VOC's:  
ON-SITE GROUNDWATER

COMPOUND	I (mg/kg-day)	SF (mg/kg-day)	RISK
Trichloroethylene	$6.86 \times 10^{-4}$	$1.1 \times 10^{-2}$	$7.5 \times 10^{-6}$
1,1,1-trichloroethane	$1.29 \times 10^{-3}$	ND	NC
1,1-dichloroethylene	$4.06 \times 10^{-4}$	$6.0 \times 10^{-1}$	$2.4 \times 10^{-4}$
1,1-dichloroethane	$5.21 \times 10^{-4}$	ND	NC
1,2-c-dichloroethylene	$1.27 \times 10^{-4}$	ND	NC
Sum of Risks .....			$2.47 \times 10^{-4}$

ND - No Data in Summary Tables  
NC - Not Calculated

TABLE 5B

LINEAR LOW DOSE CARCINOGENIC RISK FOR VOC's:  
OFF-SITE GROUNDWATER

COMPOUND	I (mg/kg-day)	SF (mg/kg-day)	RISK
trichloroethylene	$7.125 \times 10^{-6}$	$1.1 \times 10^{-2}$	$7.84 \times 10^{-8}$
1,1,1-trichloroethane	$2.53 \times 10^{-5}$	ND	NC
1,1-dichloroethylene	$7.125 \times 10^{-6}$	$6.0 \times 10^{-1}$	$4.27 \times 10^{-6}$
1,2-dichloroethylene	$7.125 \times 10^{-6}$	ND	NC
1,1-dichloroethane	$7.125 \times 10^{-6}$	ND	NC
tetrachloroethylene	$9.12 \times 10^{-6}$	$5.1 \times 10^{-2}$	$4.65 \times 10^{-7}$
Sum of Risks .....			$4.81 \times 10^{-6}$

ND - No Data in Summary Tables  
NC - Not Calculated

## 6.4 CALCULATION OF NON-CARCINOGENIC RISKS: VOC'S IN GROUNDWATER

The following equation was used to calculate non-carcinogenic risks (from Risk Assessment Guidance for Superfund Volume I):

$$\text{Noncancer Hazard Quotient (NHQ)} = E/\text{RfD}$$

Where: E = Exposure or Intake (I)  
RfD = Reference Dose

Risk calculations are presented in Table 6.

TABLE 6A

### NON-CANCER HAZARD QUOTIENTS FOR VOC'S IN DRINKING WATER: ON-SITE

COMPOUND	E (mg/kg-day)	RfD CHRONIC (mg/kg-day)	RfD SUB-CHRONIC (mg/kg-day)	NHQ CHRONIC	NHQ SUB- CHRONIC
Trichloroethylene	$6.86 \times 10^{-4}$	ND	ND	NC	NC
1,1,1-trichloroethane	$1.29 \times 10^{-3}$	$9 \times 10^{-2}$	$9 \times 10^{-3}$	0.014	0.14
1,1-dichloroethylene	$4.06 \times 10^{-4}$	$9 \times 10^{-3}$	$9 \times 10^{-3}$	0.045	0.045
1,1-dichloroethane	$5.21 \times 10^{-4}$	$1 \times 10^{-1}$	$1 \times 10^0$	0.0052	0.00052
1,2-c-dichloroethane	$1.27 \times 10^{-4}$	$1 \times 10^{-2}$	$1 \times 10^0$	0.0127	0.000127
TOTAL				0.0769	0.185

ND = No data in summary tables.

NC = Not calculated.

TABLE 6B

### NON-CANCER HAZARD QUOTIENTS FOR VOC'S IN DRINKING WATER: OFF-SITE

COMPOUND	E (mg/kg-day)	RfD CHRONIC (mg/kg-day)	RfD SUB-CHRONIC (mg/kg-day)	NHQ CHRONIC	NHQ SUB- CHRONIC
Trichloroethylene	$7.12 \times 10^{-6}$	ND	ND	NC	NC
1,1,1-trichloroethane	$2.53 \times 10^{-5}$	$9 \times 10^{-2}$	$9 \times 10^{-3}$	$2.47 \times 10^{-4}$	$2.81 \times 10^{-3}$
1,1-dichloroethylene	$7.125 \times 10^{-6}$	$9 \times 10^{-3}$	$9 \times 10^{-3}$	$7.92 \times 10^{-4}$	$7.92 \times 10^{-4}$
1,2-dichloroethylene	$7.125 \times 10^{-6}$	$1 \times 10^{-2}$	$1 \times 10^0$	$7.25 \times 10^{-4}$	$7.25 \times 10^{-6}$
1,1-dichloroethane	$7.125 \times 10^{-6}$	$1 \times 10^{-1}$	$1 \times 10^0$	$7.125 \times 10^{-5}$	$7.125 \times 10^{-6}$
tetrachloroethylene	$9.12 \times 10^{-6}$	$1 \times 10^{-2}$	$1 \times 10^{-1}$	$9.12 \times 10^{-4}$	$9.12 \times 10^{-5}$
TOTAL				$2.68 \times 10^{-3}$	$8.99 \times 10^{-3}$

ND = No data in summary tables.

NC = Not calculated.

## 6.5 CALCULATION OF RISK: VOC'S IN SOIL

This risk would be limited to exposure to trichloroethylene in area #1. Under present land use, there would be no exposure risk since area #1 is not frequented by Dixon workers and access to this portion of the property is prohibited without prior authorization from Dixon management. Therefore, any risk associated with the trichloroethylene in area #1 would require a change in land use.

Only carcinogenic risk was calculated for exposure to the trichloroethylene, since there is no data in the Health Effects Summary Tables on non-carcinogenic risk reference doses for this compound. The following equation was used to calculate the chemical intake.

$$I = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where: I = Intake (mg/kg-day)  
Cs = Chemical concentration in soil (0.0043 mg/kg)  
IR = Ingestion rate (100 mg/day)  
CF = Conversion factor ( $10^{-6}$  kg/mg)  
FI = Fraction ingested from contaminated source (0.25)  
EF = Exposure frequency (365 days/year)  
ED = Exposure duration (70 years)  
BW = Body weight (70 kg)  
AT = ED x EF (10,950)

This equation yields an intake of  $3.58 \times 10^{-7}$  mg/kg-day. Use of this intake in the equation for linear low dose carcinogenic risk ( $Risk = I \times (Sf)$ ) yields the following:

$$Risk = (3.58 \times 10^{-7}) (1.1 \times 10^{-2}) = 3.25 \times 10^{-5}$$

## **7.0 RISK ASSESSMENT: METALS**

### **7.1 FATE AND TRANSPORT ASSESSMENT**

#### **7.1.1 General**

Heavy metals (specifically lead, arsenic, cadmium, chromium) have been detected at elevated concentrations in the soils at areas #1, #4 and #7 on the Dixon property. However, in order to perform a worst case risk assessment, it is necessary to assume that the metals may eventually leach into the groundwater and impact the Dixon production well and downgradient wells, under current land use, or impact on-site residential wells under possible future land use.

Since metals have not been detected in the groundwater, it was necessary to perform fate and transport modelling to obtain estimates of the concentration of metals that may enter the groundwater and be transported downgradient.

#### **7.1.2 Modelling Calculations**

Fate and transport modelling equations were obtained from EPA document 540 2-89 057, "Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples". Specifically, equations were drawn from the case studies for Gieger/C&M Oil and Pristine, Inc.

The first step in determining potential concentration of metals in groundwater is to determine the concentration of metals in the

infiltrate reaching the groundwater, using the following equation:

$$C_p = \frac{C_s}{K_d}$$

Where:  $C_p$  = Concentration in infiltration (ug/l)  
 $C_s$  = Concentration in soil (ug/kg)  
 $K_d$  = Equilibrium partition coefficient (ml/g)

$K_d$  was calculated using the following equation:

$$K_d = K_{oc} \times F_{oc}$$

Where:  $K_{oc}$  = organic carbon partition coefficient (from EPA document 540 2-89 057).  
 $F_{oc}$  = Fraction of organic carbon in the soil

The  $F_{oc}$  value was obtained from Hoover, et al, 1971, by averaging  $F_{oc}$  values from 5 samples of Mahatango shale from Schuylkill County. The value used was 0.23. This is a conservative value since it was obtained from rock and not soil, and soil typically contains a higher percentage of organic matter.

Since these calculations are intended to determine metals concentration in groundwater, average concentrations of metals in each area were used. To use the highest concentration found in individual samples collected during the RFI would be overly conservative. This is because the individual samples are representative of areas of approximately 500-1,000 ft<sup>2</sup>. However, upon reaching the groundwater, leachate from these areas would mix in the groundwater, becoming more thoroughly mixed with distance downgradient. Metals concentrations in soil in each area and the averages used in calculations are listed in Table 7.

TABLE 7

## METALS CONCENTRATIONS IN AREAS #1, #4 AND #7

AREA 1 <sup>1</sup>	INDIVIDUAL SAMPLES CONCENTRATIONS (mg/kg)	ARITHMETIC AVERAGE (mg/kg)	UPPER 95% CONFIDENCE LIMIT
Lead	79	79	79
Arsenic	15	15	15
Cadmium	31	31	31
Chromium	32	32	32
AREA 4 <sup>2</sup>			
Lead	63, 124	94	481
Arsenic	9.3, 5.2	7.25	33
Cadmium	9.3, 16	12.65	55
Chromium	22, 24	23	35
AREA 7 <sup>2</sup>			
Lead	227, 63, 122, 124, 44, 27, 26, 11, 25	74.3	299
Arsenic	37, 11, 14, 10, 11, 14, 11, 7.6, 7.4	13.7	20
Cadmium	1.0, 1.0, 4.4, 3.7, 1.0, 0.45, 1.0, 1.0, 1.0	1.56	2.6
Chromium	19, 18, 19, 19, 19, 22, 17, 19, 15	18.55	20

<sup>1</sup> from Table 5 of RFI Report.<sup>2</sup> from Table 7 of RFI Report.

Background sampling at the site has indicated that heavy metals occur naturally in the soils at the site (Table 5 of RFI report). Groundwater sampling of the well #8 cluster indicates that these background concentrations do not contribute to dissolved concentrations of lead, arsenic, cadmium or chromium in the groundwater. Therefore, these background concentrations were subtracted from the average metals concentrations in Table 7 in order to obtain the true Cs that would contribute to potential leaching to the groundwater.

Calculation results for Kd and Cp are located in Table 8.



TABLE 8

## CONCENTRATIONS OF METALS IN INFILTRATE REACHING GROUNDWATER

<u>METAL</u>	<u>Koc</u>	<u>Kd</u> (ml/g)	<u>Cs</u> (ug/kg)	<u>Cp</u> (ug/l)
<u>Area 1</u>				
Lead	5,000	1,150	79,000	68.70
Arsenic	5,000	1,150	15,000	13.04
Cadmium	500	115	31,800	269.56
Chromium	5	1.15	32,000	27,826
<u>Area 4</u>				
Lead	5,000	1,150	94,000	81.74
Arsenic	5,000	1,150	7,250	6.30
Cadmium	500	115	12,650	100.00
Chromium	5	1.15	23,000	20,000
<u>Area 7</u>				
Lead	5,000	1,150	74,300	64.60
Arsenic	5,000	1,150	13,700	11.91
Cadmium	500	115	1.56	14.69
Chromium	5	1.15	18,550	16,130

The next step is to determine the average total volume of infiltration that would reach the groundwater from areas #1, #4 and #7 and to determine a representative metals concentration in this infiltration. The following equation was used for this purpose:

$$Q_p = (V_s \times E) (A_p)$$

Where:  $Q_p$  = volumetric flow rate of infiltration (soil pore water) into aquifer (ft<sup>3</sup>/day)

$V_s$  = groundwater seepage velocity (ft/day)

$E$  = void faction (essentially the effective porosity)

$A_p$  = horizontal area of contaminated area (ft<sup>2</sup>)

$V_s$  was approximated by the average of the hydraulic conductivity values in Table 11 of the RFI report, which is 0.68 ft/day.  $E$  was assumed to be the effective porosity/specific yield of the shallow saturated zone, which was assumed at 0.01 in the Existing Conditions report and RFI report.

The areas of areas #1, #4 and #7 were estimated to be 314 ft<sup>2</sup>, 1,050 ft<sup>2</sup> and 5,000 ft<sup>2</sup>, respectively.

Calculated values for Q<sub>p</sub> are listed in Table 9.

---

TABLE 9				
VOLUMES OF INFILTRATION REACHING GROUNDWATER FOR AREAS #1, #4 AND #7				
AREA	V <sub>s</sub> (ft/day)	E	A <sub>p</sub> (ft <sup>2</sup> )	Q <sub>p</sub> (ft <sup>3</sup> /day)
#1	0.68	0.01	314	2.14
#4	0.68	0.01	1,050	7.14
#7	0.68	0.01	5,000	<u>34.00</u>
TOTAL .....				43.24

---

It should be noted that this equation yields what is probably a high estimate of Q<sub>p</sub>, since it does not consider the limiting factor of available precipitation and soil moisture. For comparison, a Q<sub>p</sub> of 34 ft<sup>3</sup>/day from area #7 equates to 189,573 ft<sup>3</sup>/mi<sup>2</sup>/day. In a report for the Delaware River Basin Commission, Wright and Associates estimated average groundwater recharge through shales in the Delaware Basin to be 29,411 ft<sup>3</sup>/mi<sup>2</sup>/day.

The Q<sub>p</sub> values and C<sub>p</sub> values were then used to calculate a weighted average of the metals concentration in the total volume of infiltration from areas #1, #4 and #7 as outlined in Table 10.

TABLE 10

AVERAGE CONCENTRATION OF METALS IN INFILTRATE  
FROM AREAS #1, #4 AND #7

-----AREA #1-----				-----AREA #4-----		
METAL	% TOTAL	CONTRIBUTED		% TOTAL	CONTRIBUTED	
=====	=====	=====	=====	=====	=====	=====
	INFILTRATE X Cp =	FRACTION (ug/l)		INFILTRATE X Cp =	FRACTION (ug/l)	
Lead	4.9	68.70	3.37	16.51	81.74	13.49
Arsenic	4.9	13.04	0.64	16.51	6.30	1.04
Cadmium	4.9	169.56	13.21	16.51	110	18.16
Chromium	4.9	27,826	1,363	16.51	20,000	3,302

-----AREA #7-----				
METAL	% TOTAL	CONTRIBUTED		WEIGHTED AVERAGE (ug/l)
=====	=====	=====	=====	=====
	INFILTRATE X Cp =	FRACTION (ug/l)		
Lead	78.63	64.60	50.79	64.28
Arsenic	78.63	11.91	9.36	11.04
Cadmium	78.63	14.69	11.55	42.92
Chromium	78.63	16,130	12,683	17,348

Once a weighted average for Cp was obtained, the concentration of each metal in the groundwater was calculated for three downgradient potential receptor points. These three points are as follows:

- 1) The Dixon production well
- 2) The point at which a metals plume would first leave the property boundary. This is anticipated to be the property boundary due south of the production well (Exhibit I).
- 3) The point at which a metals plume would cross Route 61 (Exhibit I).

Rather than attempt to calculate what a metals plume might look like in this complicated geologic terrain, the shape of the actual

VOC plume in Exhibit III was superimposed on areas #1, #4 and #7, and oriented with the hydraulic gradient. This is a reasonable approach since areas #1, #4 and #7 are aligned with the hydraulic gradient and would create a point source plume similar to that emanating from the closed lagoons. This estimated plume is shown in Exhibit I of this report.

The concentration of metals in the groundwater at each potential receptor point was calculated using the following equation:

$$C_{gw} = \frac{Q_p C_p}{Q_p + Q_{gw}}$$

Where:  $C_{gw}$  = concentration in groundwater at receptor point (ug/l)  
 $C_p$  = contaminant concentration in infiltration (ug/l)  
 $Q_{gw}$  = volumetric flow rate of groundwater (ft<sup>3</sup>/day)  
 $Q_p$  = volumetric flow rate of infiltration (soil pore water) into groundwater (ft<sup>3</sup>/day)

For these calculations,  $C_p$  was taken from the calculated weighted average in Table 10 and  $Q_p$  was taken from the total  $Q_p$  in Table 9.

$Q_{gw}$  was calculated as follows:

$$Q_{gw} = V E W d$$

Where:  $V$  = groundwater velocity (ft/day)  
 $E$  = void fraction (effective porosity specific yield)  
 $W$  = width of plume at reception point (ft)  
 $d$  = thickness of aquifer or depth of mixing zone (ft)

Groundwater velocity and effective porosity were obtained from the Existing Conditions Report and are 6.91 ft/day and 0.01, respectively. The width of the plume at each calculation point was taken from Exhibit I. The depth of the mixing zone at the production well was assumed to be 150 feet. Although the

production well is 400 feet deep, 150 feet is a general depth of the deep water bearing zones as defined by wells #8D and #3D. The depth of the mixing zone when first leaving the property boundary and when crossing Route 61 was assumed to be 40 feet. This conservative assumption was used because usable quantities of water can be obtained from depths of 30 to 60 feet (as shown by wells #4s, #5s and #8s).

Calculations of Cgw are in Table 11.

TABLE 11				
CALCULATIONS OF METALS CONCENTRATIONS IN GROUNDWATER AT POINTS DOWNGRAIDENT				
<u>POINT/METAL</u>	<u>Qp (ft<sup>3</sup>/day)</u>	<u>Cp (ug/l)</u>	<u>Qgw (ft<sup>3</sup>/day)</u>	<u>Cgw (ug/l)</u>
<u>Production Well</u>				
Lead	43.24	64.28	10,986	0.25
Arsenic	43.24	11.04	10,986	0.04
Cadmium	43.24	42.92	10,986	0.17
Chromium	43.24	17,348	10,986	68.00
<u>Leaving Property Boundaries</u>				
Lead	43.24	64.28	2,929	0.93
Arsenic	43.24	11.04	2,929	0.16
Cadmium	43.24	42.92	2,929	0.62
Chromium	43.24	17,348	2,929	252.00
<u>Crossing Route 61</u>				
Lead	43.24	64.28	3,869	0.17
Arsenic	43.24	11.04	3,869	0.12
Cadmium	43.24	42.92	3,869	0.47
Chromium	43.24	17,348	3,869	192.00

The calculated Cgw concentrations for lead, arsenic and cadmium are below the detection limits of standard analytical methods. Therefore, it is presently not possible to say whether or not these metals are present in the groundwater at these concentrations. The calculated Cgw for chromium, at each point, is above detection

limits. However, chromium was not detected in dissolved phase in wells #8S, #8I or #8D during the RFI investigation and its highest detected total concentration was 6.6 ug/l (in well #8S). Chromium was also not detected during a recent analysis of a water sample from the Dixon production well (August, 1991).

This discrepancy suggests one of 2 possible conditions:

- 1) The chromium present in the waste and debris is not as leachable as the calculations have indicated.
- 2) The chromium concentrations detected are predominantly present as constituents of weathered bedrock and/or soil grains (i.e., they are "background" concentrations), and are not leachable.

## 7.2 CALCULATION OF METALS INTAKE

### 7.2.1 Ingestion of Groundwater

Intake levels of metals in groundwater were calculated for each receptor point using the following equation from Risk Assessment Guidance for Superfund, Volume I:

$$I = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where: I = intake (mg/kg/day)  
CW = concentration in water (mg/l)  
IR = intake rate (l/day)  
EF = exposure frequency (days/year)  
ED = exposure duration (years)  
BW = body weight (kg)  
AT = EF x ED

Table 12 lists the values used in this equation for intake from the Dixon production well and for intake at the property boundary and across Route 61.

TABLE 12  
INTAKE EQUATION PARAMETERS

PARAMETER

CW	see Table 11
IR	2 l/day
EF	365 days
PW	70 kg
ED	30 years
AT	10,950

Intake values are listed in Table 13.

TABLE 13  
INTAKE OF METALS THROUGH INGESTION OF GROUNDWATER

METAL	( mg/kg-day )		
	PRODUCTION WELL	AT PROPERTY BOUNDARY	ACROSS ROUTE 61
Lead	$7.14 \times 10^{-6}$	$2.66 \times 10^{-5}$	$4.85 \times 10^{-6}$
Arsenic	$1.14 \times 10^{-6}$	$4.57 \times 10^{-6}$	$3.43 \times 10^{-6}$
Cadmium	$4.85 \times 10^{-6}$	$1.77 \times 10^{-5}$	$1.34 \times 10^{-5}$
Chromium	$1.94 \times 10^{-3}$	$7.2 \times 10^{-3}$	$5.49 \times 10^{-3}$

### 7.2.2 Ingestion of Soil

Ingestion of soil would likely occur only if land use on the Dixon site were changed. Under future use, soil ingestion would be localized in the immediate vicinities of areas #1, #4 and #7. Contact and ingestion would occur through activities such as working, gardening and playing. Since metals concentrations in

each area are different, it is necessary to calculate an intake value for each area. Additionally, since contact rates and ingestion rates between adults and children would be different, it is necessary to calculate a separate intake for children (under age 6) and adults.

The equation used to calculate intake is as follows, from the Risk Assessment Guidance for Superfund, Volume I.

$$I = \frac{Cs \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where: I = intake (mg/kg-day)  
 Cs = chemical concentration in soil (mg/kg)  
 IR = ingestion range (mg/day)  
 CF = conversion factor ( $10^{-6}$  kg/mg)  
 FI = fraction ingested from contaminated source  
 EF = exposure frequency (days/year)  
 ED = exposure duration (years)  
 BW = body weight (kg)  
 AT = ED x EF

Table 14 lists the parameters used in this equation.

TABLE 14		
INTAKE EQUATION PARAMETERS		
PARAMETER	UP TO AGE 6	ABOVE AGE 6
CS	95% confidence interval, from Table 7	
IR	200 mg/day	100 mg/day
CF	$10^{-6}$ kg/mg	$10^{-6}$ kg/mg
FI	1	0.25
EF	365 days	365 days
ED	6 years	30 years
BW	16 kg	70 kg
AT	2,190	10,950

Calculated intakes are listed in Table 15.



TABLE 15

## CALCULATED CHEMICAL INTAKES

AREA/METAL =====	Cs =====	I ABOVE AGE 6 (mg/kg-day) =====	I UP TO AGE 6 (mg/kg-day) =====
<u>Area #1</u>			
Lead	79	$2.8 \times 10^{-4}$	$9.8 \times 10^{-3}$
Arsenic	15	$5.3 \times 10^{-5}$	$1.8 \times 10^{-3}$
Cadmium	31	$1.1 \times 10^{-4}$	$3.8 \times 10^{-3}$
Chromium	32	$1.1 \times 10^{-4}$	$4.0 \times 10^{-3}$
<u>Area #4</u>			
Lead	481	$1.71 \times 10^{-3}$	$6.0 \times 10^{-2}$
Arsenic	33	$1.17 \times 10^{-4}$	$4.1 \times 10^{-3}$
Cadmium	55	$1.95 \times 10^{-5}$	$6.0 \times 10^{-3}$
Chromium	35	$1.25 \times 10^{-4}$	$4.4 \times 10^{-3}$
<u>Area #7</u>			
Lead	299	$1.06 \times 10^{-3}$	$3.7 \times 10^{-2}$
Arsenic	20	$7.1 \times 10^{-5}$	$2.5 \times 10^{-3}$
Cadmium	2.6	$9.2 \times 10^{-6}$	$3.25 \times 10^{-4}$
Chromium	70	$7.1 \times 10^{-5}$	$2.5 \times 10^{-3}$

## 7.3 CALCULATION OF NON-CARCINOGENIC RISK: PRESENT GROUNDWATER USE

Calculation of non-carcinogenic risk used the equation:

$$\text{Non-carcinogenic hazard Quotient (NHQ)} = E/RfD$$

Where: E = exposure or intake  
RfD = reference dose

Risk calculations for ingestion of groundwater are presented in Table 16.

TABLE 16

## RISK CALCULATIONS FOR INGESTION OF GROUNDWATER: METALS

RECEPTION POINT/METAL =====	E (mg/kg-day) =====	RfD CHRONIC (mg/kg-day) =====	RfD SUBCHRONIC (mg/kg-day) =====	NHQ CHRONIC =====	NHQ SUBCHRONIC =====
<u>Production Well</u>					
Lead	$7.14 \times 10^{-6}$	$1.4 \times 10^{-4}$	ND	$5.10 \times 10^{-2}$	NC
Arsenic	$1.14 \times 10^{-6}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	$1.14 \times 10^{-3}$	$1.14 \times 10^{-3}$
Cadmium	$4.85 \times 10^{-6}$	$5.0 \times 10^{-4}$	ND	$9.70 \times 10^{-3}$	NC
Chromium	$1.94 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.388	$9.7 \times 10^{-2}$
Total .....				0.449	$9.81 \times 10^{-2}$

TABLE 16 (CONT'D)

Property Boundary

Lead	$2.66 \times 10^{-5}$	$1.4 \times 10^{-4}$	ND	$1.9 \times 10^{-1}$	NC
Arsenic	$4.57 \times 10^{-6}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	$4.57 \times 10^{-3}$	$4.57 \times 10^{-3}$
Cadmium	$1.77 \times 10^{-5}$	$5.0 \times 10^{-4}$	ND	$3.5 \times 10^{-2}$	NC
Chromium	$7.2 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	1.44	$3.6 \times 10^{-1}$
Total				1.67	0.3645

Across Route 61

Lead	$4.85 \times 10^{-6}$	$1.4 \times 10^{-4}$	ND	$3.46 \times 10^{-2}$	NC
Arsenic	$3.43 \times 10^{-6}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	$3.43 \times 10^{-3}$	$3.43 \times 10^{-3}$
Cadmium	$1.34 \times 10^{-5}$	$5.0 \times 10^{-4}$	ND	$2.68 \times 10^{-2}$	NC
Chromium	$5.49 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	1.10	$2.74 \times 10^{-1}$
Total				1.16	0.28

ND = No Data in Health Effects Summary Tables

NC = Not Calculated

**7.4 FUTURE GROUNDWATER USE**

Wells that may be drilled on the Dixon property in the future could possibly encounter higher concentration of metals than calculated in the fate and transport model, depending on their depth and location. Future wells could be drilled and cased deeper, providing an additional aquifer thickness for mixing and casing off the shallower water bearing zones in which the highest concentrations of metals would most likely occur.

An estimate of future impact and risk was calculated assuming that a well was drilled to a depth of 100 feet at a distance of 50 feet downgradient from area #7. To assume a well drilled directly into area #7 would not make the case any worse, since its cone of depression would probably extend outside the boundaries of area #7, drawing in clean water for dilution. Additionally, area #7 is on a steep slope that would be inaccessible to a drilling rig. The concentration in the groundwater at this point can be calculated

using the equation from section 7.1.2.

$$C_{gw} = \frac{Q_p C_p}{Q_p + Q_{gw}}$$

Where:  $Q_p = 34 \text{ ft}^3/\text{day}$  (Table 9)  
 $C_p = 42.86 \text{ ug/l}$  (lead),  $7.56 \text{ ug/l}$  (arsenic),  $12.95 \text{ ug/l}$  (cadmium),  $4,826 \text{ ug/l}$  (chromium) from Table 8  
 $Q_{gw} = V E w d$  where  
 $V = 6.91 \text{ ft day}$ ,  $E = 0.01$ ,  $w = 200 \text{ ft.}$ ,  $d = 100 \text{ ft.}$

The resulting metals concentrations are  $1.0 \text{ ug/l}$  (lead),  $0.18 \text{ ug/l}$  (arsenic),  $0.32 \text{ ug/l}$  (cadmium) and  $115 \text{ ug/l}$  (chromium).

Intake or exposure levels were calculated using the equation from section 7.2.1:

$$I = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

All equation parameters were held the same, except that the newly calculated CW values were used. Following this calculation, non-carcinogenic hazard quotients (NHQ) were calculated using the equation from section 7.3:

$$NHQ = E/RfD$$

Results are listed in Table 17.

TABLE 17

**NON-CARCINOGENIC RISK CALCULATIONS, INGESTION OF  
GROUNDWATER UNDER POSSIBLE FUTURE RESIDENTIAL LAND USE**

COMPOUND	E mg/kg-day	RfD CHRONIC mg/kg-day	RfD SUBCHRONIC mg/kg-day	NHQ CHRONIC	NHQ SUB-CHRONIC
Lead	$4.42 \times 10^{-5}$	$1.4 \times 10^{-4}$	ND	$3.1 \times 10^{-1}$	NC
Arsenic	$8.1 \times 10^{-6}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	$8.1 \times 10^{-3}$	$8.1 \times 10^{-3}$
Cadmium	$1 \times 10^{-5}$	$5.0 \times 10^{-4}$	ND	$2.0 \times 10^{-2}$	NC
Chromium	$1.1 \times 10^{-2}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	2.2	0.55
Total				2.54	0.56

### 7.5 CALCULATION OF NON-CARCINOGEN RISK: INGESTION OF SOIL

Concentrations of non-carcinogenic risk was calculated using the equation from section 7.3:

$$\text{NHQ} = \text{E/RfD}$$

Resultant calculations are presented in Table 18.

TABLE 18

**NON-CARCINOGENIC RISK: INGESTION OF SOIL**

----- AREA #1 -----					
AGE/METAL	E mg/kg-day	RfD CHRONIC mg/kg-day	RfD SUBCHRONIC mg/kg-day	NHQ CHRONIC	NHQ SUB-CHRONIC
<u>Up to Age 6</u>					
Lead	$9.8 \times 10^{-3}$	$1.4 \times 10^{-4}$	ND	70	NC
Arsenic	$1.8 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	1.8	1.8
Cadmium	$3.8 \times 10^{-3}$	$1.0 \times 10^{-3}$	ND	3.8	NC
Chromium	$4.0 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.8	0.2
Total				76.4	2.0
<u>Above Age 6</u>					
Lead	$2.8 \times 10^{-4}$	$1.4 \times 10^{-4}$	ND	2	NC
Arsenic	$5.3 \times 10^{-5}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	$5.3 \times 10^{-2}$	$5.3 \times 10^{-2}$
Cadmium	$1.1 \times 10^{-4}$	$1.0 \times 10^{-3}$	ND	$1.1 \times 10^{-1}$	NC
Chromium	$1.1 \times 10^{-4}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	$2.2 \times 10^{-2}$	$5.0 \times 10^{-3}$
Total				2.8	0.06

TABLE 18 (CONT'D)

----- AREA #4 -----					
AGE/METAL	E mg/kg-day	RfD CHRONIC mg/kg-day	RfD SUBCHRONIC mg/kg-day	NHQ CHRONIC	NHQ SUB-CHRONIC
<u>Up to Age 6</u>					
Lead	$6.0 \times 10^{-2}$	$1.4 \times 10^{-4}$	ND	428	NC
Arsenic	$4.1 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	3.15	3.15
Cadmium	$6.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	ND	6	NC
Chromium	$340 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.88	0.22
Total				438.03	3.37
<u>Above Age 6</u>					
Lead	$1.71 \times 10^{-3}$	$1.4 \times 10^{-4}$	ND	12.21	NC
Arsenic	$1.17 \times 10^{-4}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	0.09	0.09
Cadmium	$1.95 \times 10^{-4}$	$1.0 \times 10^{-3}$	ND	0.195	NC
Chromium	$1.25 \times 10^{-4}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.025	0.006
Total				12.52	0.096
----- AREA #7 -----					
AGE/METAL	E mg/kg-day	RfD CHRONIC mg/kg-day	RfD SUBCHRONIC mg/kg-day	NHQ CHRONIC	NHQ SUB-CHRONIC
<u>Up to Age 6</u>					
Lead	$3.7 \times 10^{-2}$	$1.4 \times 10^{-4}$	ND	264	NC
Arsenic	$2.5 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	1.92	1.92
Cadmium	$3.25 \times 10^{-4}$	$1.0 \times 10^{-3}$	ND	0.25	NC
Chromium	$2.5 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.50	0.125
Total				266.67	2.045
<u>Above Age 6</u>					
Lead	$1.06 \times 10^{-3}$	$1.4 \times 10^{-4}$	ND	7.57	NC
Arsenic	$7.1 \times 10^{-5}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	0.0055	0.0055
Cadmium	$9.2 \times 10^{-6}$	$1.0 \times 10^{-3}$	ND	0.0092	NC
Chromium	$7.1 \times 10^{-5}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.014	0.0035
Total				7.6	0.009

ND - No Data in Health Assessment Summary Tables  
NC - Not Calculated

## 7.6 CARCINOGENIC EFFECTS OF METALS

While the metals addressed in this risk assessment are classified as A or B carcinogens, there is currently no approved slope factor for use in calculations. A slope factor on the order of  $10^{-5}$  is currently under review by the EPA.

While there is presently no slope factor with which to calculate a risk factor, the EPA has recommended an interim soil cleanup level of 500 to 1,000 mg/kg total lead for sites characterized as residential (OSWER directive #9355.4-02).

## **7.7 RISKS ASSOCIATED WITH DERMAL CONTACT WITH METALS IN SOIL**

### **7.7.1 Calculation of Absorbed Dose**

Significant dermal contact with the metals in the soils and debris in areas #1, #4 and #7 would not occur under present land use because of Dixon's restrictions on access and, because there is no need for workers to enter these areas to perform their duties. Significant exposure would only occur under a different land use, such as residential, where people would be playing, working, gardening, etc. Metals intake through dermal absorption was calculated for adults and for children of approximate age 6, assuming exposure to hands, arms and legs. The following equation was used for this calculation (from Risk Assessment Guidance for Superfund, Volume I):

$$\text{Absorbed Dose (mg/kg-day)} = \frac{\text{CS} \times \text{CF} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where: CS = Chemical concentration in soil (mg/kg)  
CF = Conversion factor ( $10^{-6}$  kg/mg)  
SA = Skin surface area available for contact (cm<sup>2</sup>/event)  
AF = Soil to skin adherence factor (mg/cm<sup>2</sup>)  
ABS = Absorption factor  
EF = Exposure factor  
ED = Exposure duration (years)  
BW = Body weight (kg)  
AT = Average time (days)

Absorbed dose equation parameters are listed in Table 19.

Calculated doses are listed in Table 20.

TABLE 19

ABSORBED DOSE EQUATION PARAMETERS FOR  
DERMAL CONTACT WITH SOIL

PARAMETER =====	CHILD (APPROX, AGE 6) =====	ADULT =====
CS	Upper 95% confidence limit from Table 7	
CF	$10^{-6}$	$10^{-6}$
SA	$3910 \text{ cm}^2$	$8620 \text{ cm}^2$
AF	$1 \text{ mg/cm}^2$ *	$1 \text{ mg/cm}^2$ *
ABS	$0.10$ *	$0.10$ *
EF	$182.5 \text{ event/yr}$ *	$182.5 \text{ events/yr}$ *
ED	$6 \text{ years}$	$6 \text{ years}$
BW	$16 \text{ kg}$	$70 \text{ kg}$
AT	$2,190 \text{ days}$	$10,750 \text{ days}$

\* See Appendix I

TABLE 20

CALCULATED ABSORBED DOSES, DERMAL CONTACT  
WITH METALS IN SOIL

AREA/METAL =====	CS (mg/kg) =====	DOSE, CHILD (mg/kg-day) =====	DOSE, ADULT (mg/kg-day) =====
<u>Area #1</u>			
Lead	79	$9.6 \times 10^{-3}$	$4.9 \times 10^{-3}$
Arsenic	15	$1.8 \times 10^{-3}$	$9.2 \times 10^{-4}$
Cadmium	31	$3.8 \times 10^{-3}$	$1.9 \times 10^{-3}$
Chromium	32	$3.9 \times 10^{-3}$	$2.0 \times 10^{-3}$
<u>Area #4</u>			
Lead	481	$5.8 \times 10^{-2}$	$2.9 \times 10^{-2}$
Arsenic	33	$4.0 \times 10^{-3}$	$2.0 \times 10^{-3}$
Cadmium	55	$6.7 \times 10^{-3}$	$3.4 \times 10^{-3}$
Chromium	35	$4.2 \times 10^{-3}$	$2.1 \times 10^{-3}$
<u>Area #7</u>			
Lead	299	$3.6 \times 10^{-2}$	$1.8 \times 10^{-2}$
Arsenic	20	$2.4 \times 10^{-3}$	$1.2 \times 10^{-3}$
Cadmium	2.6	$3.2 \times 10^{-4}$	$1.6 \times 10^{-4}$
Chromium	20	$2.4 \times 10^{-3}$	$1.2 \times 10^{-3}$

### 7.7.2 Calculation of Non-Carcinogenic Risk

The non-cancer hazard quotient (NHQ) was calculated using the equation:

$$NHQ = E/RfD$$

Where: E = Exposure (absorbed dose, mg/kg-day)  
RfD = Reference dose (mg/kg-day)

Results of these calculations are listed in Table 21.

TABLE 21

#### NON-CARCINOGENIC RISK: DERMAL CONTACT WITH SOIL

AGE/METAL	E (mg/kg-day)	RfD CHRONIC (mg/kg-day)	RfD SUB-CHRONIC (mg/kg-day)	NHQ CHRONIC	NHQ SUB-CHRONIC
----- AREA #1 -----					
<u>Child</u>					
Lead	$9.6 \times 10^{-3}$	$1.4 \times 10^{-4}$	ND	68.57	NC
Arsenic	$1.8 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	1.38	1.38
Cadmium	$3.8 \times 10^{-3}$	$1.0 \times 10^{-3}$	ND	3.80	NC
Chromium	$3.9 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.78	0.195
Total				74.53	1.575
<u>Adult</u>					
Lead	$4.9 \times 10^{-3}$	$1.4 \times 10^{-4}$	ND	35.00	NC
Arsenic	$9.2 \times 10^{-4}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	0.71	0.71
Cadmium	$1.9 \times 10^{-3}$	$1.0 \times 10^{-3}$	ND	1.90	NC
Chromium	$2.0 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.40	0.10
Total				38.01	0.81
----- AREA #4 -----					
<u>Child</u>					
Lead	$5.8 \times 10^{-2}$	$1.4 \times 10^{-4}$	ND	414.28	NC
Arsenic	$4.0 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	3.10	3.10
Cadmium	$6.7 \times 10^{-3}$	$1.0 \times 10^{-3}$	ND	6.70	NC
Chromium	$4.2 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.84	0.21
Total				424.92	3.31
<u>Adult</u>					
Lead	$2.9 \times 10^{-2}$	$1.4 \times 10^{-4}$	ND	207.14	NC
Arsenic	$2.0 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	2.31	2.31
Cadmium	$3.4 \times 10^{-3}$	$1.0 \times 10^{-3}$	ND	3.40	NC
Chromium	$2.1 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.42	0.11
Total				213.27	2.42



TABLE 21 (CONT'D)

----- AREA #7 -----					
AGE/METAL	E (mg/kg-day)	RfD CHRONIC (mg/kg-day)	RfD SUB-CHRONIC (mg/kg-day)	NHQ CHRONIC	NHQ SUB-CHRONIC
=====	=====	=====	=====	=====	=====
<u>Child</u>					
Lead	$3.6 \times 10^{-2}$	$1.4 \times 10^{-4}$	ND	257.14	NC
Arsenic	$2.4 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	1.85	1.85
Cadmium	$3.2 \times 10^{-4}$	$1.0 \times 10^{-3}$	ND	0.32	NC
Chromium	$2.4 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.42	0.12
Total	.....	.....	.....	259.73	1.97
<u>Adult</u>					
Lead	$1.8 \times 10^{-2}$	$1.4 \times 10^{-4}$	ND	128.57	NC
Arsenic	$1.2 \times 10^{-3}$	$1.3 \times 10^{-3}$	$1.3 \times 10^{-3}$	0.92	0.92
Cadmium	$1.6 \times 10^{-4}$	$1.0 \times 10^{-3}$	ND	0.16	NC
Chromium	$1.2 \times 10^{-3}$	$5.0 \times 10^{-3}$	$2.0 \times 10^{-2}$	0.24	0.06
Total	.....	.....	.....	129.89	0.98
ND = No data in Summary Tables					
NC = Not Calculated					

### 8.0 ECOLOGICAL RISK ASSESSMENT

This section is intended to provide a brief, qualitative evaluation of the potential impacts of the VOC's and metals at the Dixon site on wildlife and ecology.

**VOC's:** VOC's are significant only in the groundwater, and therefore would present no threat to wildlife on or around the Dixon site. The nearest groundwater discharge point is Pine Creek and Deer Lake. As discussed in the RFI report, by the time VOC's discharge into the creek and the lake, they would be so dilute as to be insignificant and probably undetectable.

Regarding the trichloroethylene in the soil in area #1, both the

concentration and areal extent are small, and are not considered to represent a threat.

**Metals:** Regarding metals in the groundwater, this scenario would be the same as for the VOC's in groundwater. Considering the calculated concentrations of metals in the groundwater upon crossing Route 61, concentrations should be at least one half these upon entering Pine Creek which is another 1,000 feet further downgradient from Route 61.

The metals in the soil at areas #1, #4 and #7 could have some impact on wildlife. These areas are known to be frequented by deer and other small animals. However, the size of areas #1, #4 and #7 compared to the size of the total habitat is very small, and it is anticipated that these animals would actually spend very little time in these areas. Because areas #1, #4 and #7 are relatively small, any burrowing organisms that would make their homes there would be small in number compared to the total population.

There are no permanent streams nearby areas #1, #4 and #7. The closest permanent stream is Pine Creek. Therefore, fish and other water dwelling organisms would not be considered potential receptors. Additionally, because of the small surface area of areas #1, #4 and #7, they would contribute relatively little sediment to downgradient collection points.

## 9.0 CONCLUSIONS

- 1) Linear low dose carcinogenic risk calculations for ingestion of VOC's in on-site groundwater indicate that the risk for ingestion of individual components is on the order of  $10^{-4}$  to  $10^{-6}$ . The sum of risks for ingestion of all VOC's is  $2.47 \times 10^{-4}$ . It should be noted that this risk calculation assumes no treatment of groundwater prior to consumption. Groundwater from the Dixon production well is presently treated to remove VOC's before consumption. Therefore, the on-site risk would only be significant if land use and groundwater use on the site were to change.

Linear low dose carcinogenic risk calculations for ingestion of VOC's in off-site groundwater, downgradient of Dixon, indicates that the risk for ingestion of individual components is on the order of  $10^{-6}$  to  $10^{-8}$ . The sum for ingestion of all VOC's is  $4.81 \times 10^{-6}$ .

- 2) Non-cancer hazard quotients for ingestion of VOC's in on-site groundwater (assuming no prior treatment) total 0.0769 for chronic toxicity and 0.185 for sub-chronic toxicity.

Non-cancer hazard quotients for ingestion of VOC's in off-site groundwater, downgradient of Dixon, total 0.00268 for chronic toxicity and 0.00899 for sub-chronic toxicity.

- 3) Calculation of linear low dose carcinogenic risk for ingestion of trichloroethylene in the soil at area #1 indicates a risk of  $3.25 \times 10^{-5}$ .
- 4) Fate and transport calculations indicate that metals concentrations in the groundwater at downgradient receptor points would be below typical detection limits, with the exception of chromium. According to calculations, chromium should be present in concentrations ranging from 68 to 252 ug/l. However, actual sampling and analysis has shown chromium to be present at concentrations significantly lower than indicated by calculations.

Because of this discrepancy, any risk calculations using the calculated chromium values must be considered suspect.

- 5) Non-cancer hazard quotients for ingestion of metals in groundwater at Dixon production well, when first leaving property boundaries, and when crossing Route 61, total 0.449, 1.67 and 1.16 respectively, for chronic toxicity and  $9.81 \times 10^{-2}$ , 0.3645 and 0.28 respectively for subchronic toxicity.

It should be noted that all risks that exceed 1.0 do so because of the calculated concentration of chromium in the groundwater. Actual groundwater sampling data indicates that concentrations of chromium are much lower.

- 6) Non-cancer hazard quotients for ingestion of metals in groundwater, assuming future on-site groundwater consumption, total 2.54 for chronic toxicity and 0.56 for subchronic toxicity. It should be noted that chromium contributes 2.20 to the 2.54 chronic toxicity value.
- 7) Non-cancer hazard quotients for ingestion of soil from areas #1, #4 and #7 were above 1.0 for chronic toxicity for groups above and below the age of 6. Subchronic toxicity values for all areas for age groups above 6 were below 1.0.
- 8) Non-cancer hazard quotients for dermal contact with soil in areas #1, #4 and #7 were above 1.0 for chronic toxicity for children and adults. Sub-chronic toxicity values were also above 1.0 with the exception of adults in areas #1 and #7.
- 9) Because of the limited extent of areas #1, #4 and #7, the limitations of VOC's to the groundwater and large distance to groundwater discharge points, the metals and VOC's are not believed to pose a serious threat to population of local wildlife and natural communities.

## **APPENDIX I**

### **EPA Comments on Risk Assessment**



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
841 Chestnut Building  
Philadelphia, Pennsylvania 19107

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

DEC 2 1991

Frank P. Murphy, Director of Research  
Dixon Ticonderoga Co.  
1706 Hayes Avenue  
Sandusky, Ohio 44970

RE: Dixon Wearever, Deer Lake PA  
Risk Assessment

EPA has completed its review of the Dixon Wearever, September 1991, Risk Assessment Report. Several deficiencies must be addressed before the Risk Assessment report can be approved. EPA's comments are as follows:

**Section 4.0 Chemical Toxicity**

1. Chronic and subchronic health effects are seen upon inhalation and oral exposure to Chromium III. Therefore, Table 1A must include the inhalation and oral toxicity values for chromium III.

2. The inhalation data for 1,1-dichloroethylene, cadmium and arsenic must be listed. Since no data is listed in the Health Effects Summary Table for inhalation, the oral reference dose (RfD) is applied.

3. Chromium (IV) listed in table 1B should be Chromium (VI).

**Section 5.0 Exposure Pathways**

1. The pathways of the constituent of concern listed in Table 2A are acceptable. However, the reasoning for listing or not listing potential receptors is unacceptable and must be modified. Specifically, Table 2A states that VOCs impacted the groundwater only. This statement is incorrect because VOCs were detected in the soil samples of area 1, 4, and 7. EPA acknowledges area 4 and 7 have been excavated. However, area 1 has not been excavated. The trichloroethylene in area 1 must be discussed for potential risk. If Dixon's area 1 risk assessment concludes no risk exists then the report can discuss this area as posing no risk. Also Dixon must include a discussion on why the detected level of compounds listed in Table 5 of the July Dixon RFI report were determined to be non-detects and subsequently not addressed in the risk assessment.

2. Also Dixon states that no VOCs attributable to Dixon were detected off-site above MCLs. This statement is misleading, therefore, Table 2A must include a discussion of the following points:

a) Dixon's conclusion that the VOCs detected in the trucking company well are not attributable to Dixon must be discussed in this Risk Assessment report.

b) VOCs were detected in other off site wells, other than the trucking company. Therefore, this data must be discussed in the Risk Assessment report. Specifically, from the 1/10/91 sampling event, the 0.001 ppm tetrachloroethylene in R-2, 0.0036 ppm 1,1,1-trichloroethane in R-19, 0.0049 ppm 1,1,1-trichloroethane in R-25. From the 6/26/90 sampling event the 1.11 trichloroethane in the driving range. (See below, #4)

#### 6.0 Risk Assessment: VOCs

1. The four monitoring wells used in Dixon's risk assessment calculations are acceptable. However, Dixon must include all sampling events from these wells unless there is statistical temporal change event in the concentration of contaminants in the well. This can not include effects from any ongoing pump and treatment of the groundwater.

2. The narrative states that someday the compounds listed in Table 3 may migrate off site in the listed concentration is unacceptable. Migration of contaminants off-site may only be address via fate and transport modeling. Dixon should eliminate this assumption.

3. The risk calculation must be corrected to  $\text{Risk} = I \times S_f$

4. Dixon must calculate the off-site risk using all data to date. See comment in Section 5, 2.b. Non-detects should be treated as one-half the detection limit in any wells in which contamination has been found or is likely to be found. This includes the wells tested that are down gradient of the migrating plume. Therefore since 1,1,1-trichloroethane was detected in the driving range well, any subsequent sampling data from this well must use the one-half the detection limit for TCA or the detected amount. Chemicals that have been quantified in wells upgradient to the driving range well should be included in the risk assessment at one-half the detection limit, if it would be reasonable to assume the migration of these chemicals to offsite wells.



## Section 7.0 Risk Assessment: Metals

1. The assumption, used in Table 12, that the production well is a transient source is unacceptable. Dixon must use the residential future use scenario. Therefore, the 2 l/day standard intake ratio for residential use must be used.

2. In Table 14 Dixon must calculate and use the 95% Upper Confidence Limit (UCL). The highest concentration may be used only if a statistical number cannot be calculated. Dixon must calculate the possible dermal contact with the metals in soil. Refer to exhibit 6-15, page 6-41 of The Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A), December 1989, using:

a) an absorption factor of 10%, for arsenic, lead, cadmium, and chromium

b) soil to skin adherence factor of  $1 \text{ mg/cm}^2$

c) exposure frequency of 12 hours/day for children, 8 hours/day for adults, for spring and summer, 6 months/year

3. EPA recognizes that a slope factor has not been established to determine the carcinogenicity in ingestion of metals. Presently EPA is utilizing the lead Biokinetic Uptake Model as risk assessment tool to predict blood lead levels and aid the risk management decision on soil lead cleanup levels. This approach may be inappropriate for the Dixon site do to the lack of blood lead data. A more applicable approach may be for Dixon to follow as set forth by OSWER directive #9355.4-02 in which EPA recommends an interim soil cleanup level of 500-1000 ppm total lead for sites characterized as residential. EPA cautions Dixon that this presently established cleanup level is being revised to:

a) Account for the contribution of various media to total lead exposure, and the variability of each medium's contribution with location and age of the exposed population, and

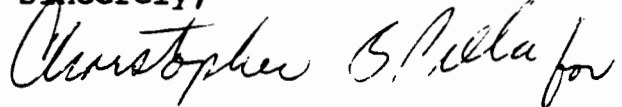
b) Provide a strong scientific basis for choosing a soil lead cleanup level specific for a given site.

Therefore, Dixon must consider the above mentioned points with the site specific data at Dixon and present a discussion in the Risk Assessment report.

Dixon must submit to EPA its response to the deficiencies cited in this letter within sixty (60) calendar days of receipt of this letter. Also as agreed upon in the November 11, 1991 Hangley Connolly Epstein Chicco Foxman & Ewing letter, Dixon must submit to EPA within 90 calendar days of receipt of this letter a Corrective Measure Study.

If you have any question please contact me at 215 597-3217 or Kathy Shelton at 215 597-5321.

Sincerely,



Cheryl Atkinson, Project Manager  
PA Corrective Action RCRA  
Enforcement Section

cc: Chris Pilla, EPA  
John Walker, Intex



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION III  
841 Chestnut Building  
Philadelphia, Pennsylvania 19107

OVERNIGHT

Frank P. Murphy, Director of Research  
Dixon Ticonderoga Co.  
1706 Hayes Avenue  
Sandusky, Ohio 44970

JAN 2 1992

RE: Dixon Wearever, Deer Lake PA  
Risk Assessment

Dear Mr. Murphy:

Please let this letter serve as an addendum to EPA's December 2, 1991, Risk assessment review letter for Dixon Wearever, Deer Lake, Pennsylvania ("the Facility"). The purpose of this letter is to provide written confirmation of our various discussions on "background soils" as they apply to the Facility's Risk Assessment. Specifically, Dixon must address the following comment:

Dixon's September 1991 Risk Assessment, Section 7.0, Metals Risk Assessment, narrative states that the metal concentrations in soil are based on subtracting background metal soil concentrations from the average detected concentration in order to obtain true soil concentrations. This is incorrect. The Risk Assessment must be adjusted to reflect the "true concentration" of metals in soil as the detected levels obtained through proper analytical procedures. Therefore, Dixon must revise Table 8, all direct and derived equations using soil concentrations, associated narratives, and subsequent tables, to include the detected soil concentrations.

Dixon may note, that soil cleanup levels, to be established during the Corrective measure Study, can consider "background" levels. However, in order to determine the potential risk to human health and the environment Dixon must consider the detected levels of contamination.

The deadlines established in EPA December 2, 1991 letter to Dixon remain unaffected by the requirements of this letter. Dixon's revised Risk Assessment, including the above requested revisions, must be received by EPA on February 3, 1992.

If you have any question please contact me at 215 597-3217 or Kathy Shelton at 215 597-5321.

Sincerely,

Cheryl Atkinson, Project Manager  
PA Corrective Action RCRA  
Enforcement Section

cc: Chris Pilla, EPA  
John Walker, Intex✓

**EXHIBIT I**  
**PROJECTED METALS PLUME IN**  
**GROUNDWATER AT DIXON WEAREVER**

